*TB 9-6625-2193-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR TRUE RMS VOLTMETER ME-545/G (RACAL-DANA, MODEL 5002)

Headquarters, Department of the Army, Washington, DC
18 February 2004

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, US Army Aviation and Missile Command, AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also provide DA Form 2028 information to AMCOM via e-mail, fax, or the World Wide Web. Our fax number is DSN 788-6546 or Commercial 256-842-6546. Our e-mail address is 2028@redstone.army.mil. Instructions for sending an electronic 2028 may be found at the back of this manual. For the World Wide Web, use https://amcom2028.redstone.army.mil.

*This bulletin supersedes TB 9-6625-2193-35, dated 19 May 1992.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of True RMS Voltmeter ME-545/G (Racal-Dana, Model 5002). The manufacturer's manual and purchase specifications were used as the prime data sources in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. None.

b. Time and Technique. The time required for this calibration is approximately 1.5 hours, using the dc and low frequency technique.

2. Forms, Records, and Reports

a. Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25.

b. Adjustments to be reported are designated (R) at the end of the sentence in which they appear. When adjustments are in tables, the (R) follows the designated adjustment. Report only those adjustments made and designated with (R).

3. Calibration Description. TI parameters and performance specifications which pertain to this calibration are listed in table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications		
Ac voltage	Range: 100 μV to 316 V rms Frequency: 10 Hz to 20 MHz[1] Accuracy: ±(%)[2]		
	Frequency	Voltage	
		100 to 999.9 μV	1.0 mV to 300 V
	10 Hz to 49.99 Hz	5.0	5.0
	50 Hz to 19.9 kHz	5.0	3.0
	20 kHz to 99.9 kHz	5.0	3.0
	100 kHz to 999.9 kHz	5.0	5.0[3]
	1.0 MHz to 9.99 MHz	10.0	10.0[3]
	10 MHz to 20 MHz	15.0	15.0[3]

[1]100 μV range only checked at 50 Hz and 1 kHz (calibration points of DT72A Ratio Transformer), 10.00 V and 31.62 V ranges not checked above 1 MHz, 100.0 V range not checked above 500 kHz, and 316.2 V range not checked above 100 kHz due to standards limitations.
[2]Accuracy based on purchase specifications and does not agree with manufacturer's specifications.
[3]Volts-hertz product not to exceed 1 x 10^8.

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Transfer Calibration Standards Set AN/GSM-286. Alternate items may be used by the calibrating activity. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 2. The accuracies listed in table 2 provide a four-to-one ratio between the standard and TI.

5. Accessories Required. The accessories required for this calibration are common usage accessories issued as indicated in paragraph **4** above and are not listed in this calibration procedure.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
CALIBRATOR	Ac voltage: Range: 3.16 mV to 300 V Frequency: 20 Hz to 1 MHz Accuracy: ±(%) Frequency: 20 Hz, 100 kHz & 500 kHz…1.25 1 and 50 kHz……0.75 1 MHz……2.50 Wideband voltage: Voltage: 316 μV to 3.0 V Frequency: 500 kHz to 20 MHz (1 kHz reference) Amplitude flatness: ±(%) Frequency: 500 kHz ……1.25 5 MHz……2.50 20 MHz……...3.75	John Fluke, Model 5720A(5700A/EP) (p/o MIS-35947); w/power amplifier John Fluke, 5725A) (5725A)
DIGITAL MULTIMETER	Range: 4.9 to ±15 V dc Accuracy: ±3.3 %	John Fluke, Model 8840A/AF-05/09 (AN/GSM-64D)
RATIO TRANSFORMER	Range: 0.001 Frequency:50 Hz, 1 kHz Accuracy:[1]	ESI DT72A (7915908)

[1]Combined accuracy of calibrator and ratio transformer for 100 μV and 316.2 μV at 50 Hz and 1 kHz output is ±0.75%.

SECTION III
CALIBRATION PROCESS

6. Preliminary Instructions

a. The instructions outlined in paragraphs **6** and **7** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name as listed in table 2.

c. Unless otherwise specified, verify the results of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Additional maintenance information is contained in the manufacturer's manual for this TI.

d. When indications specified in paragraph **8** are not within tolerance, perform power supply check prior to making adjustments. If adjustments are made, repeat paragraph **8**. Do not perform power supply check if parameter is within tolerance.

e. Unless otherwise specified, all controls and control settings refer to the TI.

7. Equipment Setup

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

a. Remove protective cover from TI only when necessary to make adjustments. Replace cover after completing the adjustments.

b. Connect to an appropriate ac voltage source and press LINE switch to ON. Allow at least 30 minutes for warm-up.

c. Set front panel **ISOLATE** switch to **ISOLATE**.

d. Press **RECALL** key, then press **0** key twice.

e. Press **SHIFT** and **FILTER** keys to **ON**.

8. Voltage Accuracy

a. Performance Check

(1) Connect calibrator **OUTPUT** terminals to ratio transformer **INPUT** and ratio transformer **OUTPUT** to TI **INPUT** terminals.

(2) Set ratio transformer dial settings to **.**0010000.

(3) Set TI and calibrator output as indicated in table 3. TI will indicate within the specified limits, if not perform **b** below.

Table 3. Voltage Accuracy

Test instrument		Calibrator output		Test instrument indications		Adj. (R)
Range	Filter	Voltage	Frequency	Min	Max	
100.0 µV	On	100 mV	50 Hz	95.0 µV	105.0 µV	---
100.0 µV		100 mV	1.0 kHz	95.0 µV	105.0 µV	---
316.2 µV		316 mV	50 Hz	300.2 µV	331.8 µV	---
316.2 µV		316 mV	1.0 kHz	300.2 µV	331.8 µV[1]	---
Set calibrator to **STANDBY** and remove ratio transformer from setup.						
1.000 mV		1.0 mV	20 Hz	.950 mV	1.050 mV	---
1.000 mV		1.0 mV	1.0 kHz	.970 mV	1.030 mV[1]	R45[2]
1.000 mV	Off	1.0 mV	50 kHz	.970 mV	1.030 mV	---
3.162 mV	On	3.16 mV	20 Hz	3.002 mV	3.318 mV	---
3.162 mV		3.16 mV	1.0 kHz	3.065 mV	3.255 mV[1]	R58[3]
3.162 mV	Off	3.16 mV	50 kHz	3.065 mV	3.255 mV	---
10.00 mV	On	10.0 mV	20 Hz	9.50 mV	10.50 mV	---
10.00 mV		10.0 mV	1.0 kHz	9.70 mV	10.30 mV[1]	---
10.00 mV	Off	10.0 mV	50 kHz	9.70 mV	10.30 mV	---
31.62 mV	On	31.6 mV	20 Hz	30.02 mV	33.18 mV	---
31.62 mV		31.6 mV	1.0 kHz	30.65 mV	32.55 mV[1]	R38[3]
31.62 mV	Off	31.6 mV	50 kHz	30.65 mV	32.55 mV	---
100.0 mV	On	100 mV	20 Hz	95.0 mV	105.0 mV	---
100.0 mV		100 mV	1.0 kHz	97.0 V	103.0 mV[1]	---
100.0 mV	Off	100 mV	50 kHz	97.0 mV	103.0 mV	---
100.0 mV		100 mV	100 kHz	95.0 mV	105.0 mV	C11[3]
316.2 mV	On	316 mV	20 Hz	300.2 mV	331.8 mV	---
316.2 mV		316 mV	1.0 kHz	306.5 mV	325.5 mV[1]	R27[3]
316.2 mV	Off	316 mV	50 kHz	306.5 mV	325.5 mV	---
316.2 mV		316 mV	500 kHz	300.2 mV	331.8 mV	---
1.000 V	On	1.0 V	20 Hz	.950 V	1.050 V	---
1.000 V		1.0 V	1.0 kHz	.970 V	1.030 V[1]	---
1.000 V	Off	1.0 V	50 kHz	.970 V	1.030 V	---
1.000 V		1.0 V	500 kHz	.950 V	1.050 V	---
3.162 V	On	3.16 V	20 Hz	3.002 V	3.318 V	---
3.162 V		3.16 V	1.0 kHz	3.065 V	3.255 V[1]	---
3.162 V	Off	3.16 V	50 kHz	3.065 V	3.255 V	---

See footnotes at end of table.

Table 3. Voltage Accuracy (continued)

Test instrument		Calibrator output		Test instrument indications		Adj. (R)
Range	Filter	Voltage	Frequency	Min	Max	
Press the following keys: **/9//9//.//1//SHIFT//SF/**						
3.162 V		3.16 V	100 kHz	3.002 V	3.318 V	C5[3, 4]
Press the following keys: **/0//SHIFT//SF/**						
3.162 V		3.16 V	100 kHz	3.002 V	3.318 V	C6[3, 4]
10.00 V	On	10 V	20 Hz	9.50 V	10.50 V	---
10.00 V		10 V	1.0 kHz	9.70 V	10.30 V	---
10.00 V	Off	10 V	50 kHz	9.70 V	10.30 V	---
10.00 V		10 V	500 kHz	9.50 V	10.50 V	---
10.00 V		10 V	1.0 MHz	9.00 V	11.00 V	---
31.62 V	On	30 V	20 Hz	28.50 V	31.50 V	---
31.62 V		30 V	1.0 kHz	29.10 V	30.90 V	---
31.62 V	Off	30 V	50 kHz	29.10 V	30.90 V	---
31.62 V		30 V	500 kHz	28.50 V	31.50 V	---
31.62 V		20 V	1.0 MHz	18.00 V	22.00 V	---
100.0 V	On	100 V	20 Hz	95.0 V	105.0 V	---
100.0 V		100 V	1.0 kHz	97.0 V	103.0 V	---
100.0 V	Off	100 V	50 kHz	97.0 V	103.0 V	---
100.0 V		40 V	500 kHz	38.0 V	42.0 V	---
RESET calibrator and connect power amplifier to setup.						
316.2 V	On	300 V	40 Hz	285.0 V	315.0 V	---
316.2 V		300 V	1.0 kHz	291.0 V	309.0 V	---
316.2 V	Off	300 V	50 kHz	291.0 V	309.0 V	---
316.2 V		300 V	100 kHz	285.0 V	315.0 V	---
RESET calibrator and disconnect power amplifier from setup.						

[1]Record TI indications.
[2]Figure 1.
[3]Figure 2.
[4]C5 and C6 interact. Repeat if C6 is adjusted.

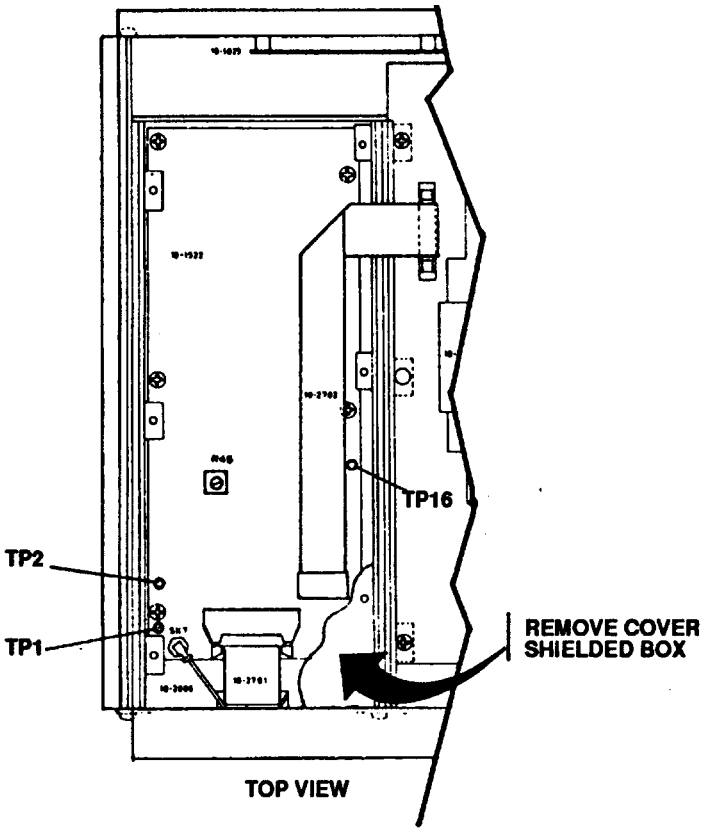

Figure 1. Top view of module assembly.

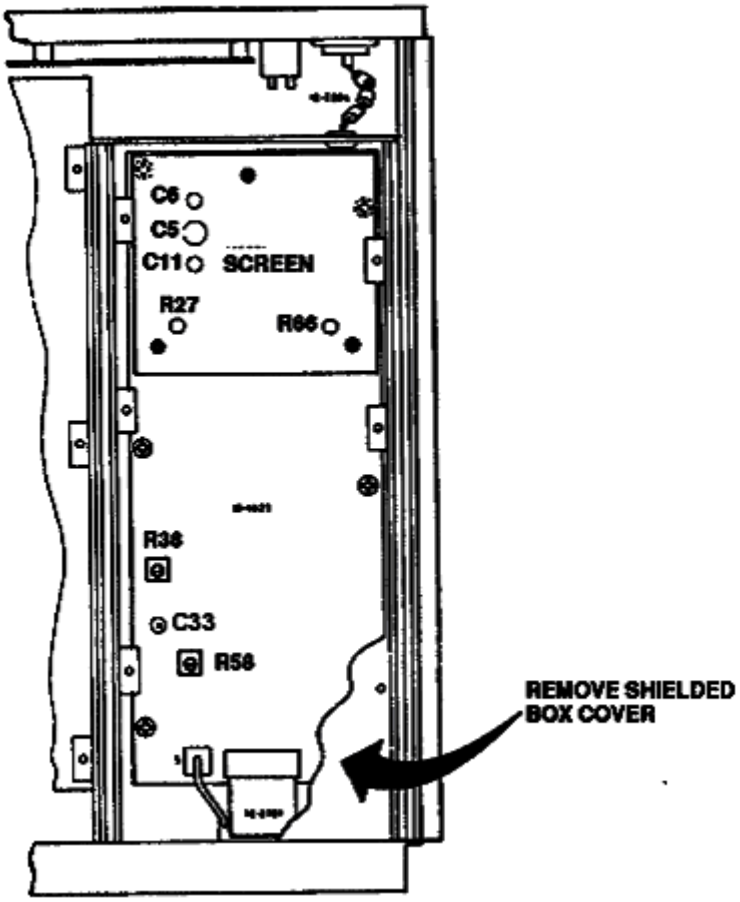

Figure 2. View of underside of module assembly.

(4) Connect TI **INPUT** to calibrator **WIDEBAND** output and press calibrator **W BND** pushbutton.

(5) Set calibrator for an initial 316 μV, 1 kHz wideband output. Adjust calibrator for a TI indication equal to value recorded in table 3 for 316 μV (1 kHz) to establish a 1 kHz reference. Press calibrator **NEW REF** pushbutton.

(6) Set calibrator frequency to 500 kHz, then readjust amplitude for TI reference established in (4) above. If calibrator **Error** display readout does not indicate within ±5%, perform **b** below.

(7) Repeat technique of (5) above for remaining frequencies listed for the 316.2 μV range in table 4. Calibrator **Error** display indication will be within the limits specified.

(8) Repeat technique of (4) through (6) above for remaining calibrator initial voltage and frequencies listed in table 4.

b. Adjustments.

(1) Set calibrator output for an initial 1.000V, 1kHZ wideband output. Adjust calibrator for TI indication equal to the value recorded in table 3 for 1.000V, 1kHz, to establish a 1 kHz reference. Press calibrator **NEW REF** pushbutton.

(2) Set calibrator frequency to 10 MHz and adjust A3C33 fig. 2 for value recorded in table 3 for 1.000V, 1 kHz. Repeat steps **8 a** (4) through (6) above (R).

Table 4. Voltage Accuracy (To 20 MHz)

Test instrument range	Calibrator		
	Output		
	Initial voltage	Frequency (MHz)	Error display limits ±(%)
316.2 µV	---	5.0	10.0
316.2 µV	---	20	15.0
1.000 mV	1.0 mV[1]	0.5	5.0
1.000 mV	---	5.0	10.0
1.000 mV	---	20	15.0
3.162 mV	3.16 mV[1]	0.5	5.0
3.162 mV	---	5.0	10.0
3.162 mV	---	20	15.0
10.00 mV	10 mV[1]	0.5	5.0
10.00 mV	---	5.0	10.0
10.00 mV	- --	20	15.0
31.62 mV	31.6 mV[1]	0.5	5.0
31.62 mV	---	5.0	10.0
31.62 mV	---	20	15.0
100.0 mV	100 mV[1]	5.0	10.0
100.0 mV	---	20	15.0
316.2 mV	316 mV[1]	5.0	10.0
316.2 mV	---	20	15.0
1.000 V	1.0 V[1]	5.0	10.0
1.000 V	---	20	15.0
3.162 V	3.16 V[1]	5.0	10.0
3.162 V	---	20	15.0

[1]Repeat technique of (4) above to establish 1 kHz reference.

9. Power Supply

NOTE

Do not perform power supply check if all other parameters are within tolerance.

a Connect digital multimeter positive lead to TP16 and negative lead to TP1 (fig. 1). If digital multimeter does not indicate +15.0 (±0.5) V, adjust R44 (fig. 3) for a +15.0 V indication (R).

b. Move positive lead to TP2 (fig. 1). If digital multimeter does not indicate -15.0 (±0.5) V, adjust R49 (fig. 3) for a -15.0 V indication (R).

c. Move positive lead to TP3 (fig. 3). Digital multimeter will indicate + 5.0 (±0.25) V.

d. Move positive lead to pin 1 of R34 (fig. 3). Digital multimeter will indicate +9.3 (±1.0) V.

e. Move positive lead to TP10 (fig. 3). Digital multimeter will indicate +4.9 (±0.4) V.

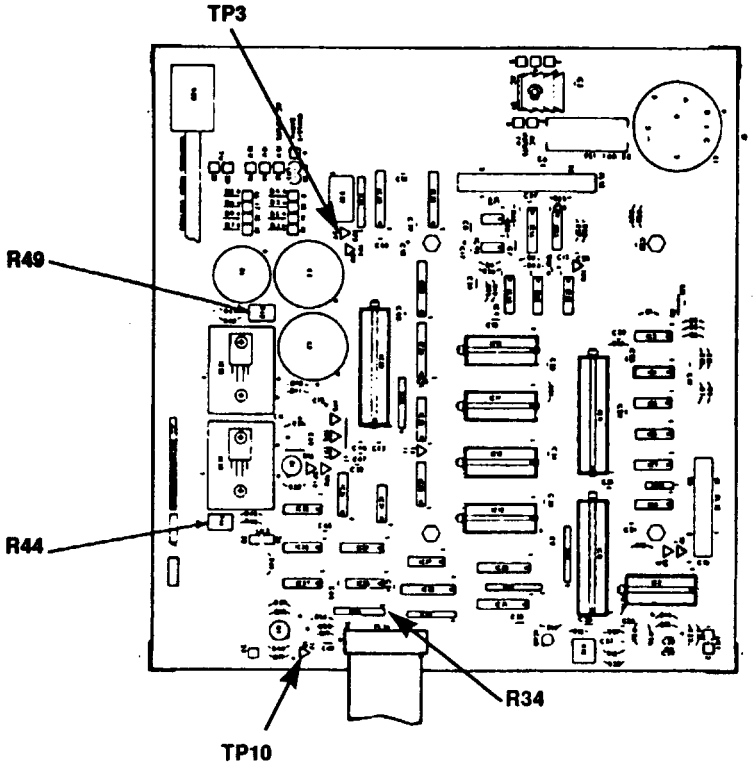

Figure 3. View of underside of module assembly.

10. Final Procedure

a. Deenergize and disconnect all equipment.

b. Annotate and affix DA label/form in accordance with TB 750-25.

By Order of the Secretary of the Army:

Official:

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General, United States Army
Chief of Staff

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0400501

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Subject: DA Form 2028

1. **From**: Joe Smith
2. Unit: home
3. **Address**: 4300 Park
4. **City**: Hometown
5. **St**: MO
6. **Zip**: 77777
7. **Date Sent**: 19-OCT –93
8. **Pub no:** 55-2840-229-23
9. **Pub Title**: TM
10. **Publication Date**: 04-JUL-85
11. Change Number: 7
12. Submitter Rank: MSG
13. **Submitter FName**: Joe
14. Submitter MName: T
15. **Submitter LName**: Smith
16. **Submitter Phone**: 123-123-1234
17. **Problem**: 1
18. Page: 2
19. Paragraph: 3
20. Line: 4
21. NSN: 5
22. Reference: 6
23. Figure: 7
24. Table: 8
25. Item: 9
26. Total: 123
27. **Text**

This is the text for the problem below line 27.